Anisotropic Quad Mesh Generation Based on Discrete Surfaces

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In this paper a new object-oriented approach is presented for anisotropic quad-dominant mesh generation on discrete surfaces. The ability to generate grids automaticly had a pervasive influence on many application areas in particularly on the field of Computational Fluid Dynamics (CFD). In spite of considerable advances in automatic grid generation there is still potential for better performance and higher element quality. The aim is to generate meshes with less elements which fit some anisotropy criterion to maintain numerical exactness while speeding up processing times remarkably.

The generation of high quality volume meshes using an advancing front algorithm relies heavily on an appropriate surface mesh. For this reason this paper presents a new technique for the generation of anisotropic surface meshes that obey some quality criteria. The output meshes consist of anisotropic quadrilaterals with some remaining triangular elements. The main properties of the algorithm are:

- The algorithm works on high resolution triangular meshes. These meshes were generated using a standard grid generation technique working on CAD data [1],[2]. The input triangular meshes are the base for the anisotropic quad dominant mesh generation.
- Only a part of the complete triangular mesh will be retriangulated into an anisotropic quad-dominant mesh, e.g. the airplane wing.
- An anisotropy-source has to be specified, e.g. a line source consisiting of all mesh edges defining the leading edge of the wing.
- A two step approach is used for the process of anisotropic quad mesh generation:
  - An isotropic quad mesh is generated applying a q–morph method adapted to discrete surfaces in 3D.
  - The final anisotropic mesh is generated by topological operations which merge quad elements.

Finally, some results are presented showing the benefits of this approach.

References

[1] F. Deister, U. Tremel, E. H. Hirschel, and H. Rieger, "Automatic Feature-Based Sampling of Native CAD Data for Surface Grid Generation," to appear in Numerical Notes on Fluid Mechanics, Springer Verlag, Berlin, 2003.

[2] L. Fornasier, F. Deister, U. Tremel, O. Hassan, and N. P. Weatherill, "Robust and Efficient Generation of Unstructured Surface Grids about Geometrically Complex Configurations Using "Real-Design" CAD Data," AIAA 2003-0805, 2003.